Office of Food Safety and Shellfish

2005 Annual Inventory:

Commercial and Recreational Shellfish Areas of Washington State

Washington State Department of Health

Office of Food Safety and Shellfish

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Commercial and Recreational Shellfish Areas of Washington State

June 2006

The Department of Health works to protect and improve the health of people in Washington State

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Contents

List of Figures

INTRODUCTION

This is the seventeenth edition of the *Annual Inventory of Commercial and Recreational Shellfish Areas of Washington State.* Formerly titled the *Annual Inventory of Commercial and Recreational Shellfish Areas of Puget Sound,* the name was recently amended to more accurately reflect the scope of this document, which includes Washington's coastal waters as well as those of the Puget Sound.

This publication is produced by the Washington State Department of Health, Office of Food Safety and Shellfish (DOH). It provides important health information about shellfish resources in Washington's marine waters and contributes to the fulfillment of the Puget Sound Conservation and Recovery Plan.

The Puget Sound Conservation and Recovery Plan, administered by the Puget Sound Action Team, is the state's strategy for protecting Puget Sound's health — its water quality and its biological resources. DOH participates with many other agencies to carry out the plan.

Included with this publication is a poster-size map of the state's shellfish growing areas. This map includes features such as commercial growing area classifications, major streams, sewage treatment plant outfalls, and recreational shellfish beach classifications. Comments or suggestions are welcome for future editions. Map information is available in electronic GIS format.

Please contact Jan Jacobs at (360) 236-3316 with any comments or requests for this publication. An electronic copy of this publication can be found on the Internet at www.doh.wa.gov/ehp/sf/pubs.

DEFINITIONS AND PROCESS FOR CLASSIFYING COMMERCIAL SHELLFISH GROWING AREAS

DOH classifies all commercial shellfish growing areas in Washington State as Approved, Conditionally Approved, Restricted, or Prohibited. These classifications have specific standards associated with them, which are derived from the *National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish* (Chapter IV, 2003 Revision).

Definitions

Approved Areas

This classification authorizes the harvesting of shellfish for direct marketing. DOH may classify a growing area as Approved when pollution source evaluations and the bacteriological water quality data show that fecal material, pathogenic microorganisms, and poisonous or deleterious substances are not present in dangerous concentrations.

The bacteriological quality of marine water samples collected from an Approved growing area must satisfy both parts of the following standard:

- The concentration of fecal coliform bacteria, the indicator organisms, cannot exceed a geometric mean of 14 organisms per 100 milliliters (ml); and
- The estimated 90th percentile cannot exceed 43 organisms per 100 ml if sampling under the systematic random scheme. If sampling where point sources of pollution may impact the growing area, not more than 10 percent of the samples can exceed 43 organisms per 100 ml.

A minimum of 30 samples is used for these calculations with the Public Health Laboratory using the A-1 modified, 5-tube/3-dilution method to estimate the most probable number of fecal coliform bacteria.

Even if the Approved criteria are met for fecal coliform bacteria, DOH may classify a growing area as Conditionally Approved, Restricted, or Prohibited (see definitions below) if pollution source investigations show that contamination may impact the sanitary condition of shellfish in the area. Because fecal coliform bacteria are not always good indicators of the presence of disease-causing viruses and other pathogens, DOH depends on thorough evaluations of pollution sources. DOH temporarily closes Approved shellfish growing areas when events such as floods or biotoxin blooms occur.

Conditionally Approved

A growing area that meets Approved criteria only during predictable periods may be

classified as Conditionally Approved. For example, in some growing areas DOH has been able to show that Approved criteria are met except for several days following a particular amount of rainfall. DOH manages the area by closing it for a specified time period following that quantity of rainfall.

Restricted

If the bacteriological water quality of a commercial growing area does not meet the standard for an Approved classification, but the sanitary survey indicates only a limited degree of pollution, the area may be classified as Restricted. Shellfish harvested from Restricted growing areas cannot be marketed directly, but must be "relayed" to an Approved growing area where they can naturally purge themselves of contaminants. The cleansing period required is generally a few weeks to several months. Restricted classifications are considered only where levels of pollution are low and relay times are shown to purify the shellfish prior to marketing.

Prohibited

DOH must classify a growing area as Prohibited when information indicates that fecal material, pathogenic microorganisms, or poisonous or deleterious substances may be present in dangerous concentrations. Marine waters adjacent to sewage treatment plant outfalls, marinas, and other persistent or unpredictable pollution sources must be classified as Prohibited. Commercial harvests of shellfish are not allowed from Prohibited areas.

Under the National Shellfish Sanitation Program, if DOH has not conducted a sanitary survey, it must classify the growing areas as Prohibited.

Process

The commercial growing area classification process is called a "sanitary survey" and consists of three parts. These are:

1. The *shoreline survey*, an investigation of point and nonpoint pollution sources that may impact shellfish sanitation;

2. The *marine water quality evaluation*, an analysis of the bacterial water quality in the marine water; and

3. The *meteorological and hydrographic evaluation*, an analysis of meteorological and hydrographic factors that may affect the distribution of pollutants in the area.

The purpose of the pollution source surveys and water quality studies are to ensure that the area complies with the standards associated with its classification, to modify the classification when needed, and to notify the responsible agencies about identified

contamination sources. Monitoring data and reports resulting from these studies are transmitted to local governments and the Department of Ecology. These reports are available to interested parties upon request. For more information on the classification process, contact Bob Woolrich at (360) 236-3329.

In addition to water quality monitoring and shoreline surveys, paralytic shellfish poisoning and domoic acid samples are collected in classified areas on a routine basis. (See Marine Biotoxin Monitoring Program, page 21.)

Shoreline Survey

The shoreline survey component of the sanitary survey consists of the periodic evaluation of all point and nonpoint pollution sources. DOH identifies and evaluates these by conducting field surveys in cooperation with local health departments, tribes, and the Department of Ecology. On-site sewage systems, animal farms, drainage ways, and wildlife activity are evaluated. Pollution control agencies are notified when pollution problems are found. DOH also evaluates the actual and potential impacts of point sources and establishes closure zones around wastewater treatment plants and marinas.

Figure 1. Shoreline Surveys Completed in 2005

Area	Marine Shoreline Miles	Parcels Evaluated	Drainages / Discharges Evaluated
Herron Island	6	123	2
Nisqually Reach	14	198	132
Peale Passage	12	107	36
Hood Canal 7	8	267	76
Anderson Island	7	29	0
Dyes Inlet	1	9	12
Bruceport	2	8	1
Saratoga Passage	22	281	79
Holmes Harbor	16	164	17
Hood Canal 8	10	421	88
Hammersley Inlet	1	21	14
Vaughn Bay	3	99	0
Dungeness Bay	4	0	14
Agate Passage	5	90	38
Pacific Coast	28	0	62
Oak Bay	5	51	0
Rocky Bay	4	112	0
Penn Cove	5	52	13
Liberty Bay - Lemolo	1	28	20

During 2005, DOH completed shoreline surveys within 12 classified commercial growing areas and 7 new areas that have been requested for harvest. The completed surveys encompassed 154 marine shoreline miles, 2060 shoreline parcels, and 604 drainage/ discharge points. Figure 1 lists the areas, shoreline miles, parcels and drainage/discharge points evaluated. For more

information regarding shoreline surveys, or to request a copy of a shoreline survey report, contact Scott Berbells at (360) 236-3324.

Marine Water Quality

Marine water samples are collected to measure the concentration of fecal coliform bacteria in the growing waters. Fecal coliform bacteria can indicate the presence of pathogens that transmit hepatitis, salmonella, and other diseases to humans. DOH conducts water quality sampling throughout the year in all active commercial shellfish growing areas.

In 2005, DOH collected over 10,000 marine water quality samples from approximately 1,400 sampling stations. For more information regarding marine water quality sampling and station locations contact Jerry Lukes at (360) 236-3319.

Meteorological and Hydrographic Factors

DOH uses meteorological and hydrographic information to determine if pollution is brought into growing areas with rain or increased river flows. DOH also uses information about tides and marine water circulation patterns to determine where pollution goes and how it is dispersed and diluted. This information is obtained from other agencies as well as developed from studies done by DOH. This is described in more detail in the Closure Zone Determination section below. For more information regarding meteorological and hydrographic factors contact Frank Meriwether at (360) 236-3321.

Closure Zone Determinations

Shellfish are filter feeders and they can accumulate and concentrate nearby disease-causing organisms. Therefore it is important that the public be protected from consuming shellfish located near actual and potential sources of pollution. Closure zones are established by DOH around sources of pollution to prevent harvest and consumption of contaminated shellfish. Typical pollution sources are sewage treatment plants, marinas, and nonpoint sources such as river discharges or runoff from watersheds following heavy rainfall. There are more than 60 sewage treatment plant outfalls discharging to the marine waters of the state, some near shellfish growing areas. The daily discharge from these treatment plants varies greatly, from tens of thousands of gallons at small plants to over one hundred million gallons at the larger facilities.

DOH conducts a technical evaluation for each sewage treatment plant and marina located near an area of commercial or recreational shellfish harvest. Evaluations for each potential pollution source include inspection of the facility by a DOH engineer, gathering information on water currents and characteristics near the site, and evaluating the dilution and dispersion of any wastewater discharged from the facilities. Frequently DOH

conducts its own studies to better understand the movements of marine waters in the area if such information is not available, or works with the consultants of these facilities to generate the information. DOH studies can include the measurement of dye injected into a treatment plant's discharge by boat-mounted equipment, and the use of fixed depth floats to study the dilution, current speed, and directional flow in nearby marine waters. DOH uses information collected at marinas and sewage treatment plants in computer models to calculate the size of closure zone for each facility, using the protective assumption that an unplanned upset event or waste discharge has occurred. In addition, each sewage treatment plant is required to call DOH immediately if a bypass occurs, or if a problem occurs with the disinfection system. DOH may close the area near a pollution discharge to commercial and public recreational shellfish harvesting when this occurs, and contacts stakeholders such as local health departments, tribal and non-tribal shellfish harvesters, and the Washington State Department of Fish and Wildlife. Using this approach, the public is protected from consuming contaminated shellfish near potential pollution sources, even during unusual conditions. For more information contact Frank Meriwether at (360) 236-3321.

STATUS OF COMMERCIAL SHELLFISH GROWING AREAS

In 2005, there were 94 commercial harvest areas in the state covering about 250,000 acres. Many of the classified harvest areas had multiple classifications. For example, in the area called Dungeness Bay, DOH classified portions as Approved, Conditionally Approved, and Prohibited. In 2005, DOH had 84 Approved classifications, 16 Conditionally Approved classifications, and 5 Restricted classifications. DOH managed the 16 Conditionally Approved classifications under a variety of predictable pollution circumstances as shown in Figure 2.

Since 1981, DOH has downgraded the classification of about 49,000 acres as the result of declines in sanitary conditions, and has upgraded about 21,000 acres. Between 1980 and 1995, the department downgraded the classification of almost 43,000 acres, but upgraded only about 7,000 acres. However, since 1995, about 6,000 acres have been downgraded and 14,000 have been upgraded.

In 2005, DOH downgraded a total of 641 acres in three growing areas – Port Orchard Pass, Henderson Inlet, and Annas Bay. A total of 212 acres were upgraded in Port Orchard Pass, North Bay, Burley Lagoon, and Hammersley Inlet were upgraded. Figure 3 shows the reclassifications of shellfish growing areas in 2005.

Threatened Shellfish Growing Areas

Figure 2. Conditionally Approved Areas in 2005

Area	Closure Criteria	Minimum Closure Length
Filucy Bay	≥0.5" rainfall / 24 hr.	6 days
Henderson Inlet	≥0.5" rainfall / 24 hr.	5 days
Drayton Harbor	≥0.75" rainfall / 24 hr.	6 days
Burley Lagoon	≥0.5 rainfall / 24 hr.	5 days
Oakland Bay	≥1.0" rainfall / 24 hr. or Upset at wastewater treatment plant	5 days
Dungeness Bay	Seasonal Closure	Nov 1 – Jan 31
Grays Harbor	Upset at wastewater treatment plant	7 days
Penn Cove	Upset at wastewater treatment plant	5 days
North Dyes Inlet	Combined sewer overflows	7 days
Barlow Bay	Seasonal marina	May 1 - Sept 30
Blake Island	Seasonal marina	May 1- Sept 30
Mystery Bay	Seasonal marina	May 1- Sept 30
Quilcene Boat Basin	Seasonal marina	May 1- Sept 30
Sequim Bay State Park	Seasonal marina and Sewage land applications	Sept 1-15 and 7 days after applications
Twanoh State Park	Seasonal marina	May 1- Sept 30
Mats Mats Bay	Seasonal marina	June 1 – Sept 30

Figure 3. 2005 Reclassifications of Intertidal Shellfish Growing Areas

Growing Area	County	Classification	Acreage
Port Orchard Pass	Kitsap	Downgrade - Approved to Prohibited (expanded wastewater treatment plant)	292
Port Orchard Pass	Kitsap	Upgrade – Prohibited to Approved (reduced marina closure zone)	40
Henderson Inlet	Thurston	Downgrade - Conditional to Prohibited (nonpoint pollution)	49
Annas Bay	Mason	Downgrade – Approved to Prohibited (nonpoint pollution)	300
North Bay	Mason	Upgrade – Conditional to Approved (repair of sewer collection system)	50
Burley Lagoon	Pierce	Upgrade – Restricted to Conditional (improved water quality)	72
Hammersley Inlet	Mason	Upgrade – Prohibited to Approved (wastewater treatment plant evaluation)	50

Each year DOH reviews the classification and develops an annual report for each of our shellfish growing areas. During this process, DOH identifies shellfish growing areas that marginally meet their classification. Those areas are considered to be "threatened with downgrades" and put on an "early warning list." DOH then notifies stakeholders and issues a press release about the threatened areas.

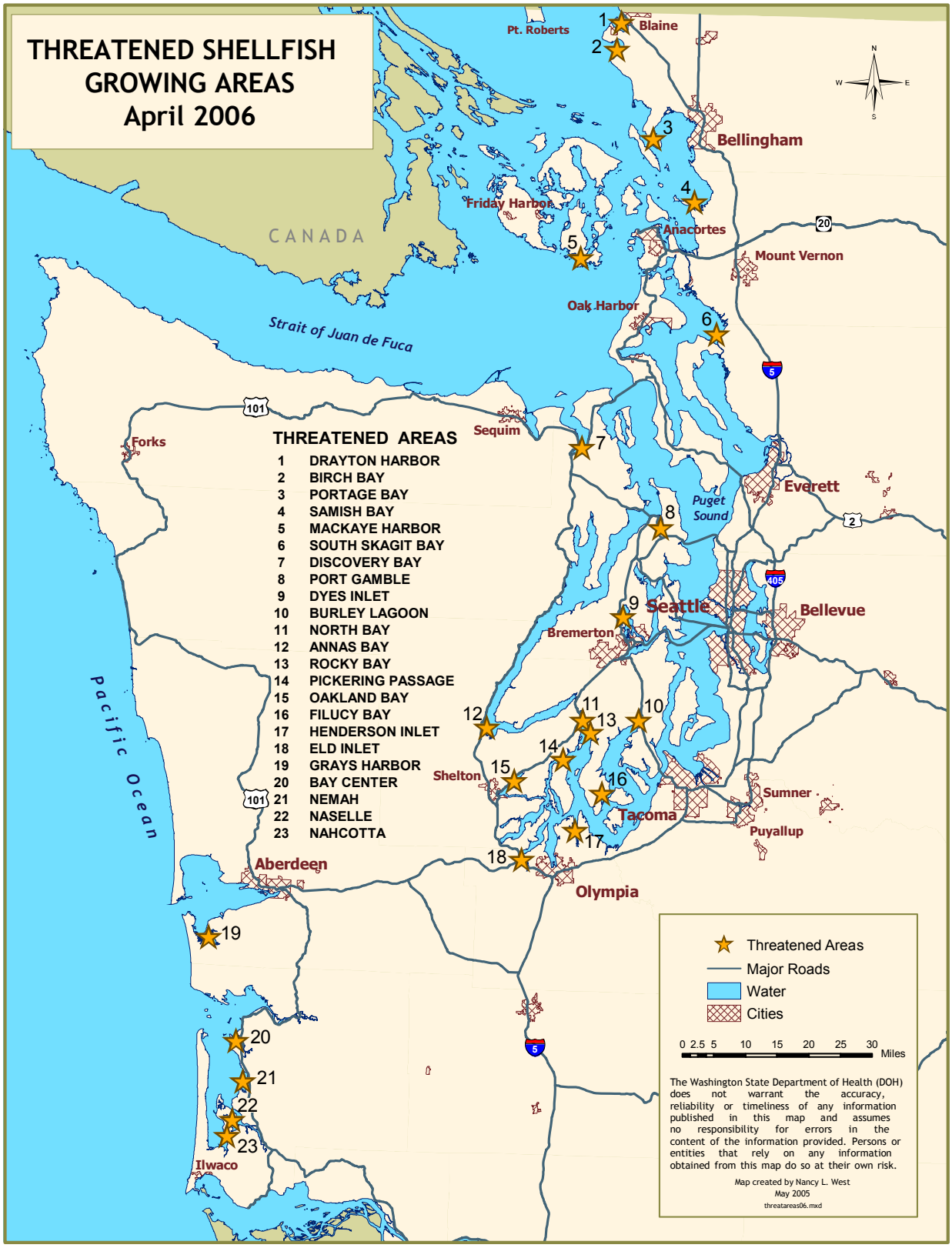
The list and the reports are sent to shellfish growers, Tribes, local governments, the Puget Sound Action Team, the Department of Ecology, Conservation Districts and the Northwest Straits Commission. The objective is to find and correct pollution problems before downgrades in classification are required.

Downgrades in classification restrict or eliminate commercial harvesting of shellfish, they close public shellfish beaches to recreational shellfish harvesters, and they indicate that pollution is getting worse. Downgrades also require a reaction. When an area is downgraded due to nonpoint pollution, state law requires local governments to form shellfish protection districts to address the problem.

According to data collected before the end of 2005, we identified the following areas as "threatened" (see Figure 4). These areas include:

- Grays Harbor / Elk River Portion (Grays Harbor County)
- Discovery Bay (Jefferson County)
- Dyes Inlet (Kitsap County)
- Port Gamble / Cedar Cove (Kitsap County)
- Annas Bay (Mason County)
- North Bay (Mason County)
- Oakland Bay (Mason County)
- Pickering Passage (Mason County)
- Bay Center (Pacific County)
- Nahcotta (Pacific County)
- Naselle River (Pacific County)
- Nemah River (Pacific County)
- Burley Lagoon (Pierce County)
- Rocky Bay (Pierce County)

Figure 4. Threatened Shellfish Growing Areas in 2005



- Filucy Bay (Pierce County)
- MacKaye Harbor (San Juan County)
- Samish Bay (Skagit County)
- South Skagit Bay (Snohomish County)
- Eld Inlet (Thurston County)
- Henderson Inlet (Thurston County)
- Birch Bay (Whatcom County)
- Drayton Harbor (Whatcom County)
- Portage Bay (Whatcom County)

For more information on threatened shellfish growing areas, contact Bob Woolrich at (360) 236-3329.

Fecal Coliform Pollution Status in Commercial Shellfish Beds of Puget Sound

DOH participates with other agencies in the Puget Sound Assessment and Monitoring Program (PSAMP) to assess the health of Puget Sound. DOH addresses two questions for PSAMP:

- What is the status of fecal pollution in shellfish beds?
- Has fecal pollution changed over time?

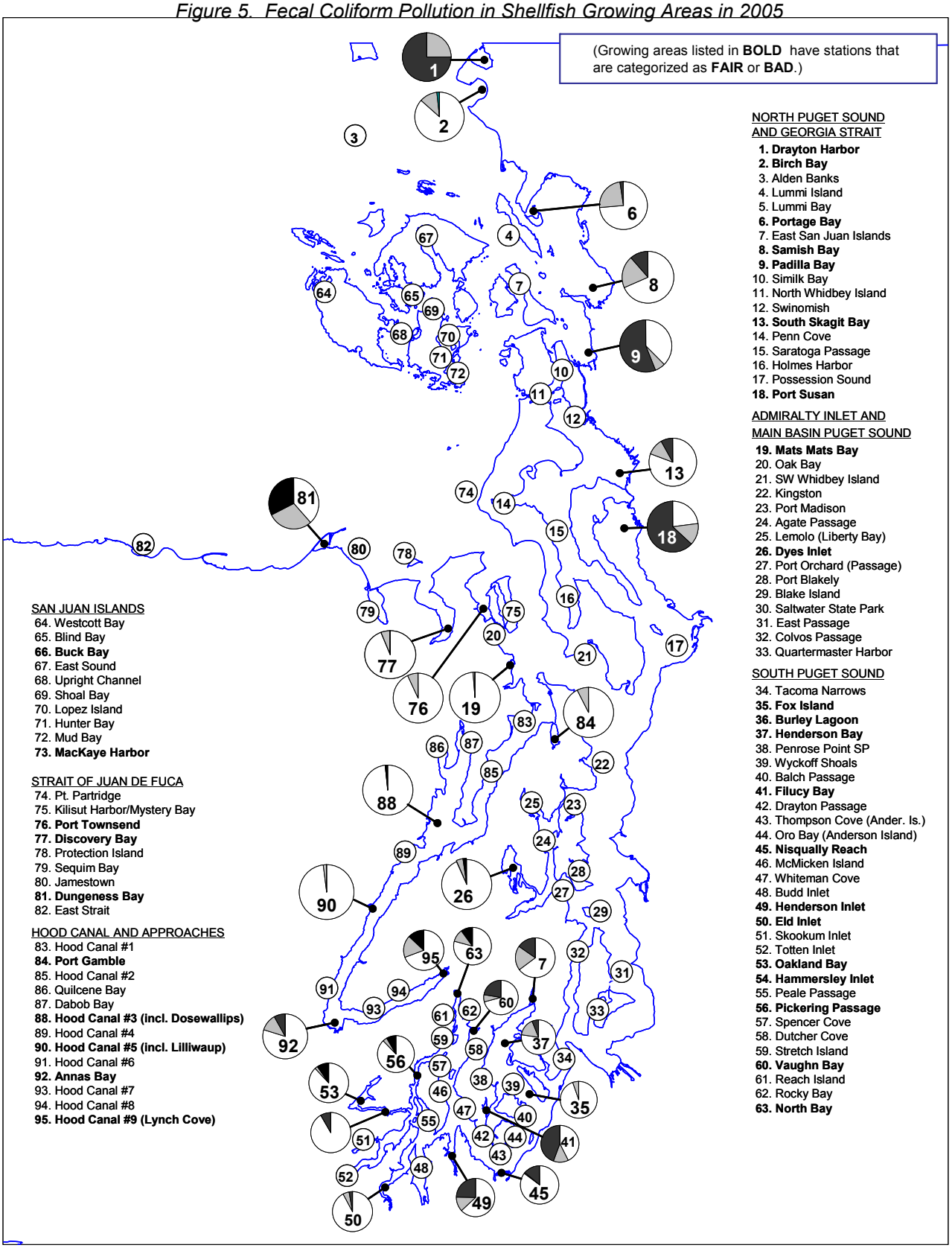
To answer these questions, fecal coliform statistics used by DOH to classify growing areas (geometric means and ninetieth percentiles) are adapted to meet PSAMP objectives. For PSAMP, statistics are calculated for each sampling date starting from the earliest date having the minimum required number of prior results (30) forward to the most recent date available. The PSAMP procedure is nearly identical to the initial steps for classifying growing areas. However, classification requires additional data analysis.

DOH recently evaluated pollution status and trends at over 1200 sampling stations in 98 commercial shellfish growing areas in Puget Sound for the year ending in December 2005.

Status of fecal pollution in shellfish growing areas

To determine pollution status, ninetieth percentiles were calculated from fecal coliform data for each station for all sampling dates in 2005. The ninetieth percentiles were sorted into

Figure 5. Fecal Coliform Pollution in Shellfish Growing Areas in 2005



three categories: **GOOD** (0-30 MPN per 100 ml), **FAIR** (31-43 MPN per 100 ml) or **BAD** (above 43 MPN per 100 ml). The ninetieth percentiles in each category were summed among all the stations in each growing area. A pie chart of the fractions of categories for each growing area can be visually compared with those for other growing areas in Puget Sound and the Straits of Georgia and Juan de Fuca (Figure 5). Drayton Harbor (near the international border), and Dungeness Bay (near Sequim on the Strait of Juan de Fuca) appear to be among the areas most affected by fecal pollution in 2005. Nearly 90% of over 8,100 ninetieth percentiles were **GOOD**, 6% were **BAD**, and the remainder were **FAIR**.

Ranking growing areas and regions with the "Fecal Pollution Index" (FPI).

A "Fecal Pollution Index" or FPI was calculated for each growing area, as follows: First,

Figure 6. Shellfish Growing Areas Ranked by Fecal Pollution Index

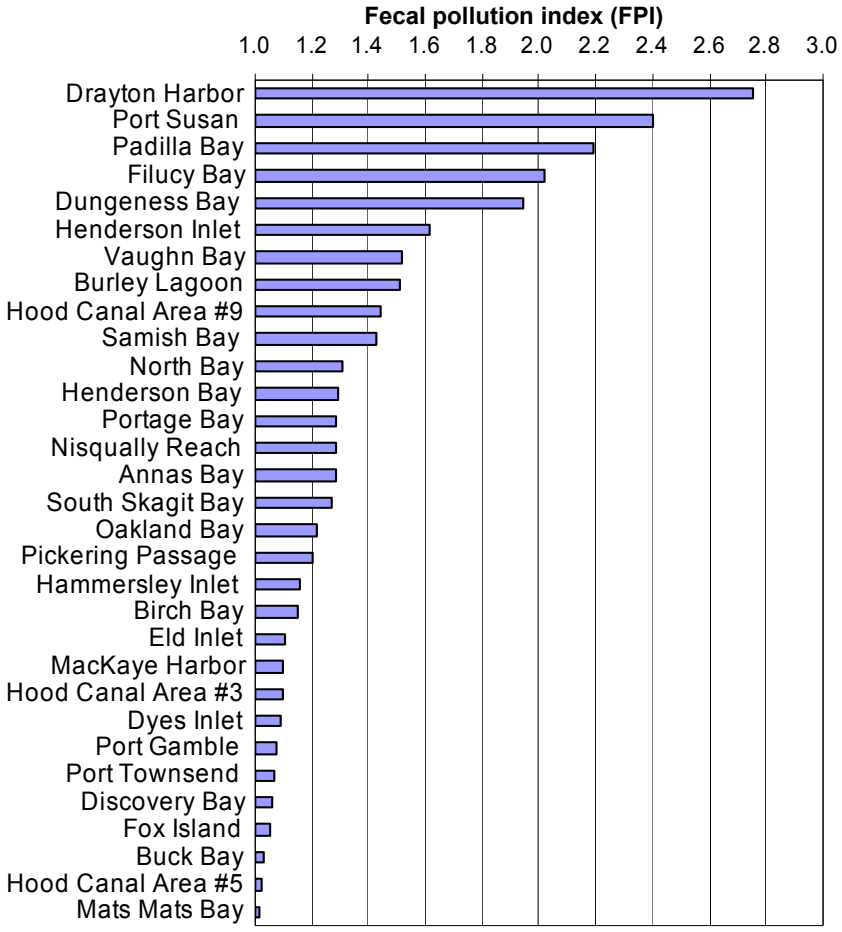
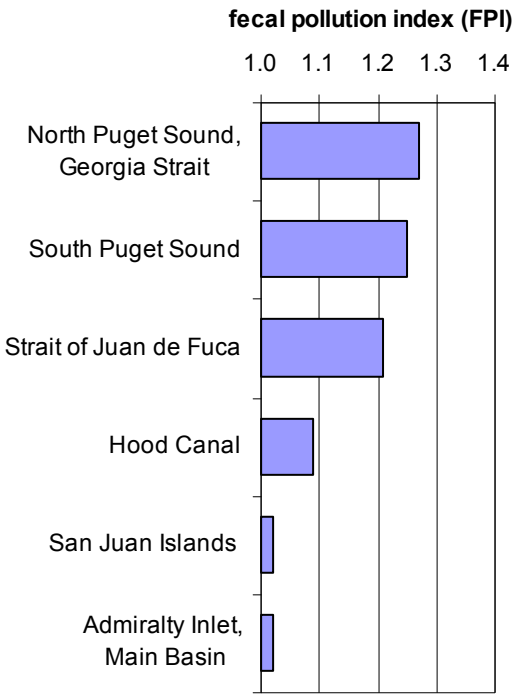


Figure 7. Regions Ranked by Fecal Pollution Impact



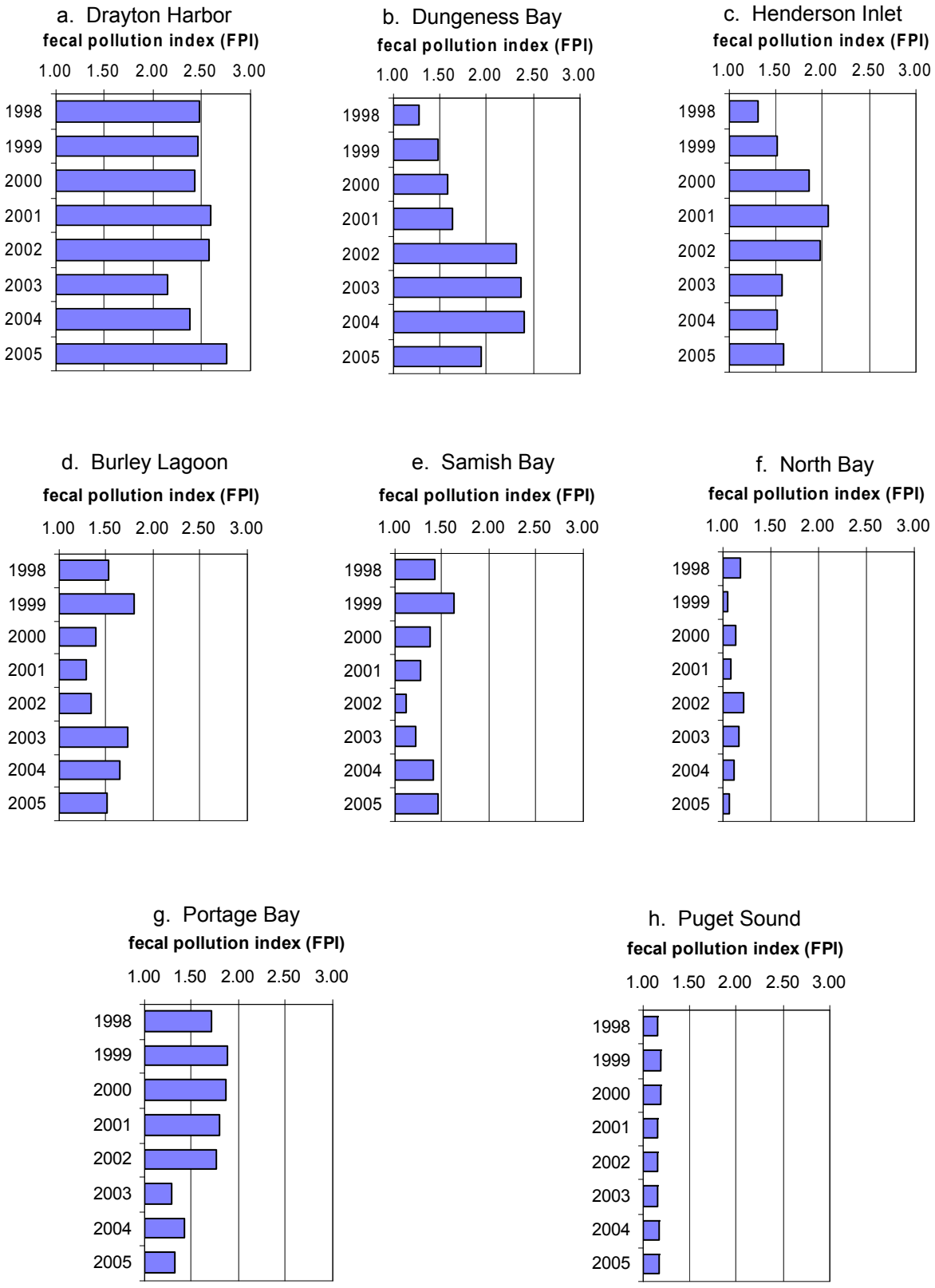
the fraction of ninetieth percentiles from all stations in a growing area was determined for each category. The fraction was then multiplied by a corresponding weighting factor (GOOD: 1.0; FAIR: 2.0; or BAD: 3.0). Next, the resulting weighted fractional values are added to produce the FPI. In simple terms, if 100% of the ninetieth percentiles in the growing area are GOOD, the index is 1.0 (1.00 x 1.0). On the other hand, an index of 3.0 means that 100% of the ninetieth percentiles are BAD (1.00 x 3.0). The FPI of a growing area with a mixture of fractions among several categories will fall somewhere between 1.0 and 3.0. Figure 6 arrays the FPIs of 31 growing areas affected by fecal pollution (i.e., FPI greater than 1.0) in 2005. The bar graphs in Figure 6 agree with our visual impressions from Figure 5. Drayton Harbor was the most affected in 2005 (FPI = 2.75).

The concept of calculating FPI was extended to the six major regions of Puget Sound. Ninetieth percentiles from all sampling stations in all areas within each region sampled in 2005 were sorted into each impact category (GOOD, FAIR, BAD). Next the weighted proportion of stations in each category was determined as described earlier. The weighted proportions were summed to produce an FPI for each of the regions. Figure 7 ranks the regions according to fecal pollution impact in 2005. North Puget Sound-Georgia Strait had the greatest impact (FPI=1.27). Admiralty Inlet - Main Basin and the San Juan Islands were the lowest (FPI=1.02).

Trend of fecal pollution in impacted shellfish growing areas

The fecal pollution index (FPI) concept was used to show trend in selected shellfish growing areas in Puget Sound. Sampling records from each growing area were carefully examined to identify sites that have been sampled continuously for at least a decade. Recently established stations were excluded. The statistics from these “standard” stations were used to calculate “standardized” annual FPIs for each year from 1998 through 2005. Figure 8a-g

Figure 8. Standardized Annual FPIs in 7 Areas and Puget Sound



shows these annual "standardized" FPIs from seven shellfish harvest areas in Puget Sound (ordered according to their 2005 FPIs). All seven areas have received remedial attention of varying intensity over the past decade or longer. Some areas show evidence of recent decrease in fecal impact (Dungeness Bay, Henderson Inlet, and Portage Bay). A changing trend in fecal pollution impact in a growing area may result from interaction among a number of factors, including the intensity of remedial action, annual rainfall patterns, land use changes, etc. For example, the fecal pollution impact in Henderson Inlet (Figure 8c) closely follows total annual rainfall, and may be a stronger influencing factor than remedial action. However, the strength of interacting factors in fecal pollution impact has not been examined in depth.

Annual "standardized" FPIs were calculated from ninetieth percentiles from all "standard" stations throughout Puget Sound (Figure 8h). The results suggest fecal pollution impact from 1998 through 2005 has been both very low and stable.

SHELLFISH GROWING AREA RESTORATION PROGRAM

The goal of the Restoration Program is to reopen commercial and recreational shellfish beds that have been closed or have harvest restrictions and to prevent the closure of more shellfish areas. The Restoration Program works cooperatively with local governments, the Puget Sound Action Team, tribes, conservation districts, the Department of Ecology, the Department of Agriculture, and shellfish growers. Program activities include water quality testing, notifying affected parties about classifications that are threatened, participating in surveys to identify pollution sources, serving on watershed committees, and assisting in the development of watershed management plans and closure response plans.

Restoration Projects

DOH Restoration Program projects in 2005 included:

Grays Harbor (Grays Harbor County) DOH worked with Ecology and the Weyerhaeuser Company to measure bacterial die-off rates and dilution in the pulp mill's effluent during major ebb tides in the south channel of the harbor. These studies resulted in a change in the mill's bacterial concentrations that trigger a closure of shellfish harvest in the harbor. This change results in fewer harvest closures while ensuring the public's health is protected.

Henderson Inlet (Thurston County) Water quality problems associated with stormwater, on-site sewage systems, and animal keeping practices persist in Henderson Inlet. Thurston County staff are continuing their efforts to identify and correct pollution sources. The County initiated an Operation and Maintenance Program to conduct regular inspections of on-site sewage systems along the Henderson Inlet shoreline and watershed.

Nisqually Reach (Thurston County) Thurston County staff are continuing their efforts to identify the pollution sources that are impacting a portion of the area near the mouth of McAllister Creek where the growing area is classified as restricted. County staff are also working on pollution sources along the northern Nisqually shoreline that were identified in the DOH shoreline survey.

Annas Bay (Mason County). Bacterial water quality in the Skokomish River improved due to remediation efforts. However, due to water quality problems 300 acres of the Annas Bay growing area was downgraded from approved to prohibited. DOH is working with Mason County, the Conservation District, and Ecology to investigate pollution sources. The County and Conservation District are conducting pollution remediation efforts in the area.

Lower Hood Canal (Mason County) DOH continued to work with Mason County to identify and correct pollution sources in the Lynch Cove area. Water quality continued to improve and approximately 138 acres of prohibited tidelands on the western portion of Belfair State Park were upgraded to approved. Recreational shellfish harvest will be allowed in 2006 for the first time in 19 years.

DOH identified a failing on-site sewage system at Twanoh State Park. DOH's Wastewater Program is currently working with State Parks to repair the system.

North Bay (Mason County) DOH continued to work with Mason County to identify the pollution sources impacting water quality along the Allyn shoreline. County staff continued to work on identifying and correcting pollution sources. As a result of this work, water quality continues to improve in North Bay. This year 50 acres of Conditionally Approved area managed on rainfall were upgraded to Approved.

Oakland Bay (Mason County) DOH is working with the Shelton Area Regional Taskforce to ensure that water quality in Oakland Bay remains protected during the proposed expansion of the area's wastewater treatment plants (WWTPs). Ecology and the City of Shelton have agreed to cap the amount of future flow that can be discharged from the Shelton WWTP into Oakland Bay. The Squaxin Tribe, Mason County, the Conservation District, DOH, and Ecology worked intensively on pollution source identification, and non-point pollution remediation activities in the Chapman Cove and north Oakland Bay area. Both areas continue to meet standards, but further pollution remediation activities are needed.

Burley Lagoon (Pierce and Kitsap Counties) DOH continued to work with Kitsap and Pierce County agencies to identify pollution sources in the watershed. This remedial work has resulted in water quality improvements. In 2005, 99 acres of Restricted area were upgraded to a Conditionally Approved managed on rainfall. In addition, 27 acres of the Approved area was downgraded to Conditionally Approved managed on rainfall.

Filucy Bay (Pierce County) High bacteria concentrations continue in the narrow northern

portion of Filucy Bay and in a small embayment along the eastern shoreline. Ongoing restoration work by Pierce County agencies in the watershed includes testing of on-site septic systems and investigations of animal keeping practices. DOH conducts monthly marine water and stream sampling in cooperation with the Tacoma-Pierce County Health Department.

South Skagit Bay (Island and Snohomish Counties) The new Stanwood wastewater treatment plant (WWTP) came on line in August 2004. Increasing population growth in Stanwood required a major upgrade and reconstruction of this plant to treat the increased wastewater flows. This WWTP discharges effluent to the old Stillaguamish Slough, which flows into South Skagit Bay. DOH was actively involved with Ecology, the City of Stanwood, and the city's consultant in ensuring that the upgraded WWTP was equipped with alarm systems and redundancies to ensure reliable treatment prior to discharge into the slough. The WWTP continuously monitors effluent quality and automatically diverts inadequately treated or disinfected effluent to a holding lagoon. DOH will continue to work with Ecology and the City to ensure that future increases in flow do not impact shellfish harvesting in South Skagit Bay.

Samish Bay (Skagit County) DOH continues to work with the Skagit County Health and Public Works departments, Samish Bay shellfish growers, and Ecology to locate and correct pollution sources in the watershed. All of the stations in the approved area comply with the water quality standards, but four stations fall into the "threatened" category. All the threatened stations lie in the flow patterns of either the Samish River or the Edison Slough.

Drayton Harbor (Whatcom County) DOH is continuing to work with the Citizens Watershed Committee, the City of Blaine Public Works Department, various Whatcom County agencies, and the Northwest Indian College to identify and correct pollution problems that continue to impact the area around the mouth of Drayton Harbor. DOH is supportive of the proposed upgrade to the Blaine WWTP that would use advanced membrane technology for treatment.

Portage Bay (Whatcom County) DOH is continuing to work with Lummi Natural Resources, Northwest Indian College, Department of Ecology, and Whatcom County Water Resources on the restoration of the Portage Bay shellfish area. Water quality continues to improve in the area and it is likely more area will be upgraded in 2006.

PUGET SOUND ASSESSMENT AND MONITORING PROGRAM

DOH participates in the Puget Sound Assessment and Monitoring Program (PSAMP). The goals of PSAMP are to:

- Assess the health of Puget Sound and its resources;

- Identify existing environmental problems;
- Provide data to help the Puget Sound Action Team and others to measure the outcome of environmental programs;
- Provide a permanent temporal record of significant natural and human-caused changes in key environmental indicators in Puget Sound; and
- Support research activities by making available scientifically valid data.

The primary goal of DOH is to assure the health and safety of shellfish consumers. Information gathered by DOH programs can also be used to meet the broader goals of PSAMP.

Data are drawn from two DOH programs: the Biotoxin Monitoring Program and the Commercial Growing Area Water Quality Monitoring Program.

The 2005 PSAMP data analysis has been shared with DOH staff for the 2006 Early Warning exercise and with local staff working on watershed restoration projects in Dungeness, North Bay, and Oakland Bay. A special analysis of Eld Inlet was done for the Puget Sound Action Team in support of a project for the Thurston County Planning Council.

LICENSING AND CERTIFICATION PROGRAM

DOH's Shellfish Licensing and Certification Program is a statewide program designed to protect the public health by licensing all commercial bivalve molluscan shellfish companies and certifying all harvest sites in Washington State. This program ensures that standards are met in the harvesting, handling, processing, packaging, buying, storage and distribution of shellfish. Through a formal agreement with the Department of Fish and Wildlife, shellfish growing areas are patrolled to prevent the illegal harvest of shellfish from unapproved waters.

Each company that harvests shellfish receives a Harvest Site Certificate that lists all certified sites from which the company is approved to harvest. Each approved site must undergo a pollution assessment to become certified. Specific identifiers are assigned to the site, and must be placed on harvest tags and transaction records. This identifier makes it possible to recall shellfish if a growing area or harvest site is closed due to a pollution or biotoxin event, or if shellfish are implicated in an illness.

Washington State Shellfish Industry

Washington State is among the top shellfish producing states in the nation, and is recognized as having one of the nation's safest supplies of shellfish. The success in

assuring that Washington shellfish are among the safest in the nation is due to the cooperative efforts of DOH, Washington tribes, and the shellfish industry.

The commercial shellfish licensing year runs from October 1 through September 30 for Shellstock Shippers and Shucker Packers. Harvester licenses run from April 1 through March 31. The Washington State shellfish industry currently consists of approximately 335 licensed certified shellfish operations. Approximately 26 firms are licensed as shucker-packers (shellfish processing firms), 224 as shellstock shippers, and 88 firms are licensed as harvesters. DOH performed 622 routine inspections of licensed shellfish operations during the 2004-2005 license year.

Shucker-Packers

Shucker-packer firms either harvest or purchase shellstock, then process it in their plants by shucking, washing, and packing the meats for sale to retail markets. These processing plants are inspected for shellfish sanitation compliance a minimum of four times a year. DOH performed 112 inspections on shucker-packer firms during the October 2004 - September 2005 license year.

Shellstock Shippers

Shellstock shipper firms either harvest, purchase or reship shellstock for sale to retail markets or to other shellfish dealers. Their licenses are limited to the sale of shellstock or shucked shellfish from other licensed shucker-packer dealers only; these firms are not permitted to shuck shellfish. Shellstock shipper firms are inspected a minimum of two times per year. DOH performed 418 inspections on shellstock-shipper firms during the 2004-2005 license year.

Harvesters

Harvester firms are limited to harvesting shellstock and selling it intrastate (only within the state of Washington) to licensed shucker-packer firms or shellstock-shipper firms. They are not permitted to purchase shellstock, nor sell it to retail. Harvesters are not permitted to shuck shellstock, or store shellstock. Harvester operations are inspected once per license year. DOH performed 92 inspections of harvester firms during the 2004-2005 license year.

For further information contact Jessie DeLoach at (360) 236-3302.

TRIBAL SHELLFISH SANITATION PROGRAM

2005 began the twelfth year of the Tribal Shellfish Sanitation Program since the *U.S. v. Washington* shellfish sub-proceeding commenced in the United States District Court of

Western Washington. In 2005, fourteen treaty tribes were certified and licensed by the Department. Those licensed as “Harvesters” were the Lower Elwha Klallam Tribe, the Muckleshoot Indian Tribe, the Nisqually Tribe, the Port Gamble S’Klallam Tribe, the Jamestown S’Klallam Tribe, the Puyallup Tribe, the Skokomish Tribe, the Squaxin Island Tribe, and the Tulalip Tribe. Those licensed as interstate “Shellstock Shippers” were the Lummi Indian Nation, the Suquamish Tribe, the Upper Skagit Indian Tribe, and the Swinomish Tribe. The Quinault Indian Nation and the Squaxin Island Tribe were licensed “Shucker-Packer” operations. Thirty-eight (38) individual tribal operations, owned and operated by tribal members, received either the “Harvester” or the “Shellstock Shipper” license.

DOH and the tribes continue their cooperative efforts to protect public health, and held regularly scheduled “technical meetings” to share information. Tribal representatives actively participate in the Interstate Shellfish Sanitation Conference (ISSC) and the Pacific Rim Shellfish Conference, providing valuable input on issues relating to the sanitary control of molluscan shellfish. The continued development of joint protocols are priorities for both DOH and the tribes.

In 2005, DOH classified two new tribal geoduck tracts in Jefferson County and processed a number of applications for harvest sites on private tidelands in Hood Canal and Dyes Inlet. Tribal personnel continue to assist with water quality monitoring for existing growing areas as well as new classification requests.

Tribal geoduck harvesting operations exist in the Strait of Juan de Fuca, Hood Canal, and central and south Puget Sound. DOH inspects geoduck boats and product landings for sanitation and proper handling of commercial product. Tribal monitors and patrol officers work with DOH to ensure a safe product by enforcing rules for harvesting in open approved areas.

In addition to commercial endeavors, cooperative efforts also benefit subsistence and recreational shellfish harvesters. DOH provides annual updates on growing areas associated with *Vibrio parahaemolyticus* illnesses, and time and temperature control measures to be applied at harvest. Tribes contract with DOH’s biotoxin laboratory to test for paralytic shellfish poison (PSP) and domoic acid in shellfish collected throughout Puget Sound and on several north Pacific Coast beaches. The results are shared with all stakeholders, including commercial harvesters, recreational harvesters, and local and state agencies.

In December 2005, a Shellfish Educational Workshop was sponsored by DOH for local health departments and tribal participation. Six tribes were represented at the workshop. DOH presented program information on classification of growing areas, shoreline surveys, recreational beaches, marine biotoxin issues, and *Vibrio parahaemolyticus*. Results of a

Tribal Partnership Building survey indicated that the tribes are satisfied with the DOH shellfish program and level of involvement and communication.

Overall, tribal involvement continues to result in increased public protection through shellfish food safety and awareness of Washington shellfish sanitation issues. For more information,

Figure 9. 2005 ICP Temperature Control and V.p. Sampling Areas

Growing Area	Maximum Hours from Harvest to Temp. Control	Months of the Year
Hammersley Inlet Hood Canal 3, 4, 5, 6, & 7 Samish Bay	12	June – September
Willapa Bay (Nahcotta/ Oystervile)	12	August – September (whenever average monthly maximum air temperature exceeds 66° F)

please contact Cathy Barker at (360) 236-3323.

VIBRIO PARAHAEMOLYTICUS IN WASHINGTON STATE

Vibrio parahaemolyticus (Vp) is a naturally occurring marine water bacterium that can cause illness through the consumption of raw or undercooked molluscan shellfish, typically during the warmer months of the year. These illnesses are of moderate severity, generally lasting

Figure 10. 2005 Vibrio parahaemolyticus Illnesses

	Commercial WA Oysters	Recreational WA Oysters	Commercial Multi-Source Oysters Including WA Oysters
Number of Confirmed Cases	16	4	3
Number of Cases by Harvest Site	6 – Willapa Bay 7 – Hood Canal 1 – Samish Bay 1 – Totten Inlet 1 – Hammersley Inlet	3 – Hood Canal 1 – Lummi Island	3 – various sources
Harvest Dates	7/18/05 – 8/24/05	7/04/05 and Unknown	Unknown
How Consumed	7 – raw shellstock 8 – raw / undercooked 1 – unknown	4 – raw	2 – raw 1 – unknown

1-7 days, and characterized by watery diarrhea and abdominal cramps.

Since the large *Vp* outbreaks of 1997-98, the state of Washington continues to experience sporadic cases of *Vp*. Little is known about the environmental factors that contribute to the growth and virulence of *Vp* bacteria in marine waters. However, proper temperature control during harvest, transportation, and storage minimizes further growth of *Vp* within the shellfish.

Growing areas that are associated with two or more confirmed illnesses in a three year period are required to follow the 2003 Interstate Shellfish Sanitation Conference V*ibrio parahaemolyticus* Interim Control Plan (ICP). The ICP prescribes sampling and laboratory requirements and specific action levels for managing shellfish harvest from implicated growing areas. Routine shellfish testing is conducted during warm months, from May through September. In 2005, sites representing nine growing areas were monitored under the ICP. Figure 9 lists these growing areas, timeframes for harvest to temperature control, and the months for the temperature control.

Vibrio Illnesses

There were no growing area closures as a result of *Vp* outbreaks or routine laboratory sample results in 2005. However, there were a total of 23 confirmed cases of *Vp* illnesses linked to Washington shellfish. Of these, 4 cases were linked to recreational harvest and 19 cases were linked to commercial product. Three of the 19 cases related to commercial product came from multiple sources including the state of Washington.

Figure 10 provides a breakout of the pertinent illness information relating to each category. For more information contact Richard Lillie at (360) 236-3313.

MARINE BIOTOXIN MONITORING PROGRAM

PSP

The state of Washington routinely experiences seasonal restrictions on commercial and recreational shellfish harvest due to paralytic shellfish poisoning (PSP), more commonly known as "red tide". The biotoxin that causes PSP temporarily interferes with the transmission of nerve impulses in warm-blooded animals. The primary symptoms of PSP in humans are numbness and tingling of the lips, tongue, face and extremities, difficulty talking, breathing, and swallowing, and muscle incoordination. Symptoms develop quickly, usually within 1-2 hours of consumption (very high levels of toxin can produce symptoms within 30 minutes), and typically disappear within 12-24 hours. There is no known antidote for the toxin. Treatment is basically supportive, i.e., artificial respiration, in life threatening cases.

PSP toxin is produced by microscopic organisms that naturally exist in marine water. The species that causes PSP in Washington marine waters is *Alexandrium catenella*. *Alexandrium* is usually present in small numbers; however, when environmental conditions are optimum, rapid reproduction occurs. Filter-feeding shellfish, which include clams, oysters, mussels and scallops, can accumulate the toxin to dangerous levels during these "blooms".

DOH monitors PSP toxin levels in shellfish from areas throughout the state. Commercial operations submit PSP samples as a condition for commercial certification. Recreational beaches are sampled as a cooperative effort between DOH, other state agencies, tribes, health departments, and citizen volunteers. Areas are closed for harvest of molluscan shellfish when PSP toxin levels equal or exceed the Food and Drug Administration standard of 80 micrograms (mg) toxin/100 grams shellfish tissue. Areas are not reopened until testing has confirmed that the PSP toxin has declined to a safe level. Butter clams (*Saxidomus giganteus*) may experience extended closures because they typically retain the PSP toxin longer than other shellfish. An annual regulatory closure for all species is in effect for the Strait of Juan de Fuca, west of Dungeness Spit and the ocean beaches from April through October. A recreational razor clam season may be held each spring and fall depending on biotoxin levels and availability of resource.

DOH maintains a toll free 24-hour "PSP Hotline" (1-800-562-5632) identifying recreational beach closures. Local health jurisdictions also issue notices through local newspapers and radio. Beach posting is irregular depending on jurisdiction, beach ownership, susceptibility to vandalism and theft, and is not a reliable method of notification.

2005 PSP Summary

The Washington State Public Health Laboratory analyzed 2,601 PSP samples in 2005. Commercial shellfish growers monitored commercial growing areas biweekly during 2005. Selected recreational beaches were monitored biweekly from April through October by local health jurisdictions, Clallam County Marine Resource Council, Puget Sound Restoration Fund, and volunteers. Sentinel mussel cage sites were monitored year-round. There were a total of 19 commercial geoduck closures in 2005. There was only one commercial shellfish recall due to marine biotoxins in Washington in 2005.

First Quarter 2005

PSP toxin levels followed the typical pattern for the first quarter of the year, with downward trends throughout the state. In Puget Sound, very few PSP closures were in effect at the beginning of 2005, and no general closures were lifted in the first quarter. There were six geoduck tract closures in the first quarter, which were likely related to blooms that occurred in the fall of 2004 rather than new bloom activity in the winter of 2005.

Second Quarter 2005

PSP toxin continued a downward trend during April. In May, North Puget Sound experienced new closures. North San Juan County and North Whatcom County, from Sandy Point to the Canadian border, were closed to all species. In June, all San Juan and Whatcom Counties closed to all species. Additionally, East Bainbridge Island in Kitsap County and an area around Port Angeles in the Strait of Juan de Fuca in Clallam County closed to all species. There were only two geoduck closures in the second quarter of 2005.

Third Quarter 2005

PSP levels began to rise in the Central Puget Sound basin in early July, requiring closures that began with parts of Vashon Island and gradually expanded to include all of King County, parts of Pierce and Snohomish counties, and east Kitsap County. Additionally, Port Ludlow and Oak Bay in Jefferson County, Nisqually Reach in Thurston County, and Drayton Harbor in Whatcom County closed to all species. This trend continued into August, causing additional closures in the Strait of Juan de Fuca in Clallam County and East Hood Canal in Kitsap County. Conversely, August saw the Whatcom County and Thurston County closures lifted. In September, Discovery Bay, Mystery Bay, Kilisut Harbor, and Port Townsend in Jefferson County closed, while Oak Bay reopened. Carr Inlet in Pierce County reduced from an all species closure to a butter clams only closure. Also, parts of East

Figure 11. Areas of Highest PSP Levels in 2005

Date	Harvest Area	Species	* Toxin Level
08/02/2005	Tramp Harbor	Blue Mussel	1,658
07/19/2005	Horse Head Bay	Blue Mussel	1,536
07/24/2005	Burley Lagoon	Blue Mussel	1,524
08/07/2005	Lofall	Blue Mussel	1,342

** Micrograms per 100 grams of shellfish meat tissue*

Kitsap County either reopened to all species or reduced to butter clam only in September. There were seven geoduck tract closures and seven commercial growing area closures in the third quarter of 2005. Those seven growing areas were Quartermaster Harbor, Sequim Bay, Discovery Bay, East Passage on East Vashon Island, Carr Inlet, Mystery Bay, and Kilisut Harbor.

Fourth Quarter 2005

Figure 12. 2005 Sentinel Biotoxin Mussel Sites

The fourth Quarter of 2005 was a busy time with both PSP openings and closures. In early October, the King County closure was lifted except for Three Trees Point to the Pierce County line which reduced to a butter clam only closure. The closure in Kitsap County from Point No Point to Port Madison was also lifted. In November, the Clallam County closure for the Strait of Juan de Fuca was opened to all species, while the Jefferson County closures for Discovery Bay and Port Ludlow were reduced to butter clam only closures. In December, the Jefferson County closures in Kilisut Harbor and Mystery Bay were reduced to butter clam only closures. Bellingham Bay in Whatcom County closed in October, reopened in December, only to close again before the end of the month. This was most unusual for this time of year. There were no commercial growing area PSP closures and only four geoduck PSP closures in the fourth quarter of 2005.

Sentinel Mussel Monitoring Program

DOH continued the Sentinel Mussel Monitoring Program as an early warning system for marine biotoxins in 2005. With assistance from local health jurisdictions, tribes, Puget Sound Restoration Fund, and volunteers, 69 collection sites were maintained and monitored biweekly to monthly. Figure 12 shows the collection site locations used in 2005.

In addition to the sentinel mussel locations, commercial mussels were routinely monitored at Westcott Bay in San Juan Island, Penn Cove in Whidbey Island, and Burley Lagoon in the Kitsap Peninsula.

Domoic Acid

Domoic acid is a naturally occurring toxin produced by species of microscopic marine diatoms of the genus *Pseudo-nitzschia*. The human illness known as amnesic shellfish poisoning (ASP) or domoic acid poisoning (DAP) is caused by eating fish, shellfish or crab containing the toxin. Symptoms include vomiting, nausea, diarrhea and abdominal cramps within 24 hours of ingestion. In more severe cases, neurological symptoms develop within 48 hours and include headache, dizziness, confusion, disorientation, loss of short-term memory, motor weakness, seizures, profuse respiratory secretions, cardiac arrhythmias, coma and possibly death. There is no antidote for domoic acid poisoning.

ASP was first characterized in 1987 on the Atlantic coast of Canada. Domoic acid was first detected on the Pacific coast in California in the summer of 1991, when a number of pelican and cormorant deaths were linked to domoic acid in anchovies. In the fall of 1991, domoic acid was detected in razor clams off the coast of Washington. This discovery brought a premature end to the recreational razor clam harvest but not before several mild cases of ASP were associated with the consumption of razor clams.

Domoic acid levels are measured using a laboratory technique called high performance

liquid chromatography (HPLC). The level of domoic acid determined to be unsafe for human consumption is 20 ppm in molluscan shellfish and 30 ppm for Dungeness crab viscera. The Dungeness crab areas are closed when three of six individual crab viscera equals or exceeds 30 ppm.

Research shows that razor clams accumulate domoic acid in the edible tissue (foot, siphon and mantle) and are slow to rid themselves of the toxin. In Dungeness crab domoic acid primarily accumulates in the viscera.

In 1991 DOH began monitoring all major shellfish growing areas for domoic acid. Until 2003, unsafe levels of domoic acid had only been detected in coastal razor clams, mussels, and Dungeness crab. In September 2003, a blue mussel sample from Marrowstone Island in Jefferson County tested 29 ppm. This was the first unsafe sample of domoic acid to be detected in any inland waters of Puget Sound.

2005 Domoic Acid Summary

Approximately 42 crab and 1,224 molluscan shellfish samples were tested for domoic acid in 2005.

First Quarter 2005

The domoic acid levels in razor clams for the first quarter of 2005 remained low, following a declining trend from December 2004. The only site on the coast that tested above the closure level of 20ppm during the first quarter of 2005 was Kalaloch, causing this area to remain closed during scheduled razor clam openings on the coast in January, February, and March. Long Beach, Twin Harbors, Copalis, and Mocrocks had three open razor clam harvest days per month in January, February, and March. Plankton monitoring revealed almost no P*seudo-nitzschia* cells present in the water in the first quarter of 2005. In February, two mussel samples from the sentinel site at Kingston on the Kitsap Peninsula tested 2 ppm for domoic acid. No toxin was detected in subsequent samples in March from the site.

Second Quarter 2005

For the second quarter of 2005, only the northern beaches maintained low levels of domoic acid in their razor clams. The southern beaches, Twin Harbors and Long Beach, began to show elevated levels in April, ultimately preventing the May opening at Long Beach. Long Beach, Twin Harbors, Copalis, and Mocrocks had six open razor clam harvest days in April, while Kalaloch had three open days. Twin Harbors, Copalis, Mocrocks, and Kalaloch had two open days for razor clam harvesting in May, while Long Beach remained closed. Elevated levels of domoic acid in the Willapa Spits razor clams prevented the commercial season from opening in May, and continued to delay the season until mid-July. Plankton

monitoring revealed a gradual increase of *Pseudo-nitzschia* cells in the water for most of the second quarter of 2005. Because of the increase in toxic plankton and an increase of domoic acid in razor clams, Dungeness crab samples were requested for testing. The test results were negative, so crab sampling was halted.

Three inland water sites experienced domoic acid in shellfish during the second quarter of 2005. Kingston had another test result of 2 ppm in June. In April, two Strait of Juan de Fuca locations, Freshwater Bay and Discovery Bay , also tested positive for domoic acid. The samples were only 1 ppm, far from the closure level of 20 ppm. However, any toxin at all at this time of year at these locations is noteworthy.

Third Quarter 2005

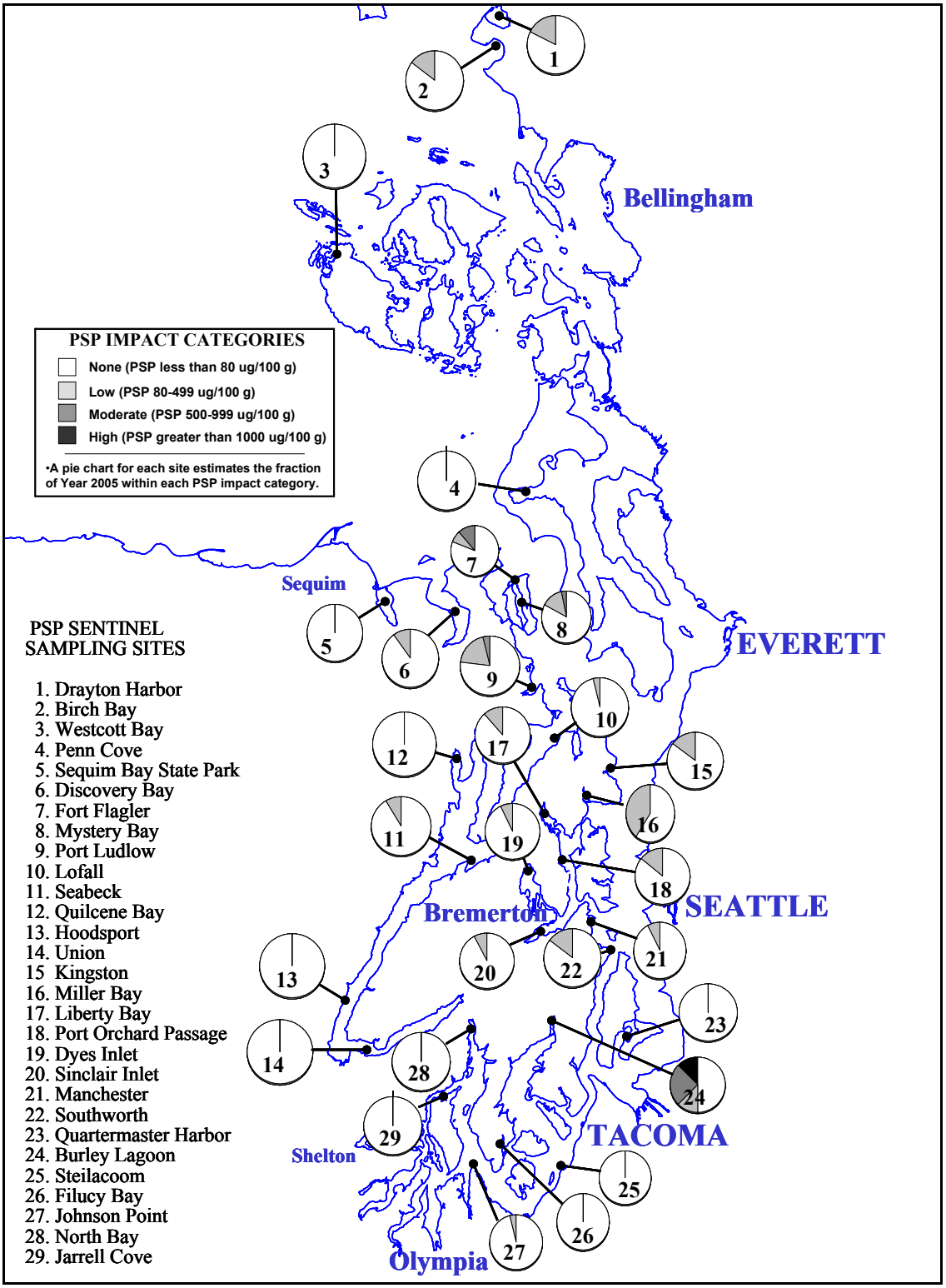
Figure 13. Areas of Highest Domoic Acid Levels in 2005

Date	Harvest Area	Species	Toxin Level *
10/18/2005	Penn Cove	Manila Clam	68
09/12/2005	South End/Blyn	Manila Clam	36
10/17/2005	Holmes Harbor	Manila Clam	32
09/12/2005	South End/Blyn	Pacific Oyster	30
05/23/2005	Willapa Spits	Razor Clam	29
10/26/2005	Saratoga Passage	Dungeness Crab	28
09/15/2005	Hardwick Point	Littleneck Clam	27
09/19/2005	Sequim Bay St Park	Blue Mussel	26
02/08/2005	Kalaloch Beach North	Razor Clam	24

** parts per million*

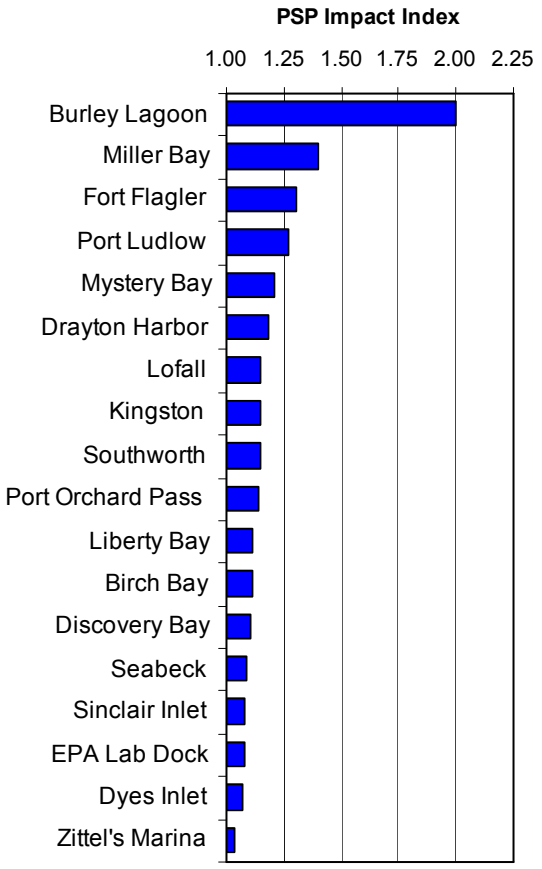
The toxin level on the southern beaches fell quickly to single digit levels during the third quarter of 2005. The toxin level for the northern razor clam beaches continued to remain low for the third quarter. This was quite surprising as the plankton monitors reported high levels of the *Pseudo-nitzschia* cells in the water during this period. While the coast remained uneventful, the inland waters did not. In September, an unprecedented domoic acid bearing plankton bloom occurred in Sequim Bay causing shellfish to reach closure levels, shutting down both sport and commercial shellfish harvesting. Manila clams with 36ppm recorded the highest domoic acid level for this bloom. Blue mussels were 26ppm, Pacific oysters were 30ppm and native littleneck clams tested 27ppm. Discovery Bay, once

Figure 14. 2005 PSP Sentinel Sites Results



again registered a test result of 1ppm in blue mussels in September. Also, blue mussels from Penn Cove on Whidbey Island had a test result of 1ppm. Domoic acid has been detected in previous years at Penn Cove, but never near closure levels.

Figure 15. Ranking of 18 of 29 total PSP Sampling Sites Impacted by PSP in 2005



Fourth Quarter 2005

The low level in toxicity in razor clams observed in the third quarter continued throughout the fourth quarter of 2005. This allowed the razor clam season to proceed unencumbered. Long Beach, Copalis and Kalaloch were each open for three days in October and November. Mocrocks and Twin Harbors were opened for four days of razor clam harvest in October and November. All five beaches were open for two days in December.

The Penn Cove domoic acid bloom that began in September went on to set new records for Puget Sound in October. Penn Cove mussels elevated to 46ppm by mid-October, Manila Clams set a new record at 68ppm in Penn Cove and reached 32ppm next door, in Holmes Harbor. At the end of the month, Cornet Bay at the top of Whidbey Island at Deception Pass also registered a 1ppm for domoic acid. This bloom represents a new threat to the health and economic well being of Washington. If domoic acid blooms continue to move into new areas of Puget Sound, the sport and commercial shell fisheries will experience more frequent and possibly longer biotoxin closures, which will necessitate a more extensive public education effort.

Summary of PSP Status for PSAMP

Each year DOH analyzes spatial and temporal trends in PSP for the Puget Sound Assessment and Monitoring Program (PSAMP). DOH has examined results from 29 of its Sentinel Monitoring Sites for Paralytic Shellfish Poisoning (PSP) toxin in Puget Sound and the Straits of Georgia and Juan de Fuca for 2005. PSP toxin is measured in mussels collected at each sentinel site (see Figure 12).

Figure 16. Five-Year Temporal Trend in PSP Intensity in Five Regions of Puget Sound

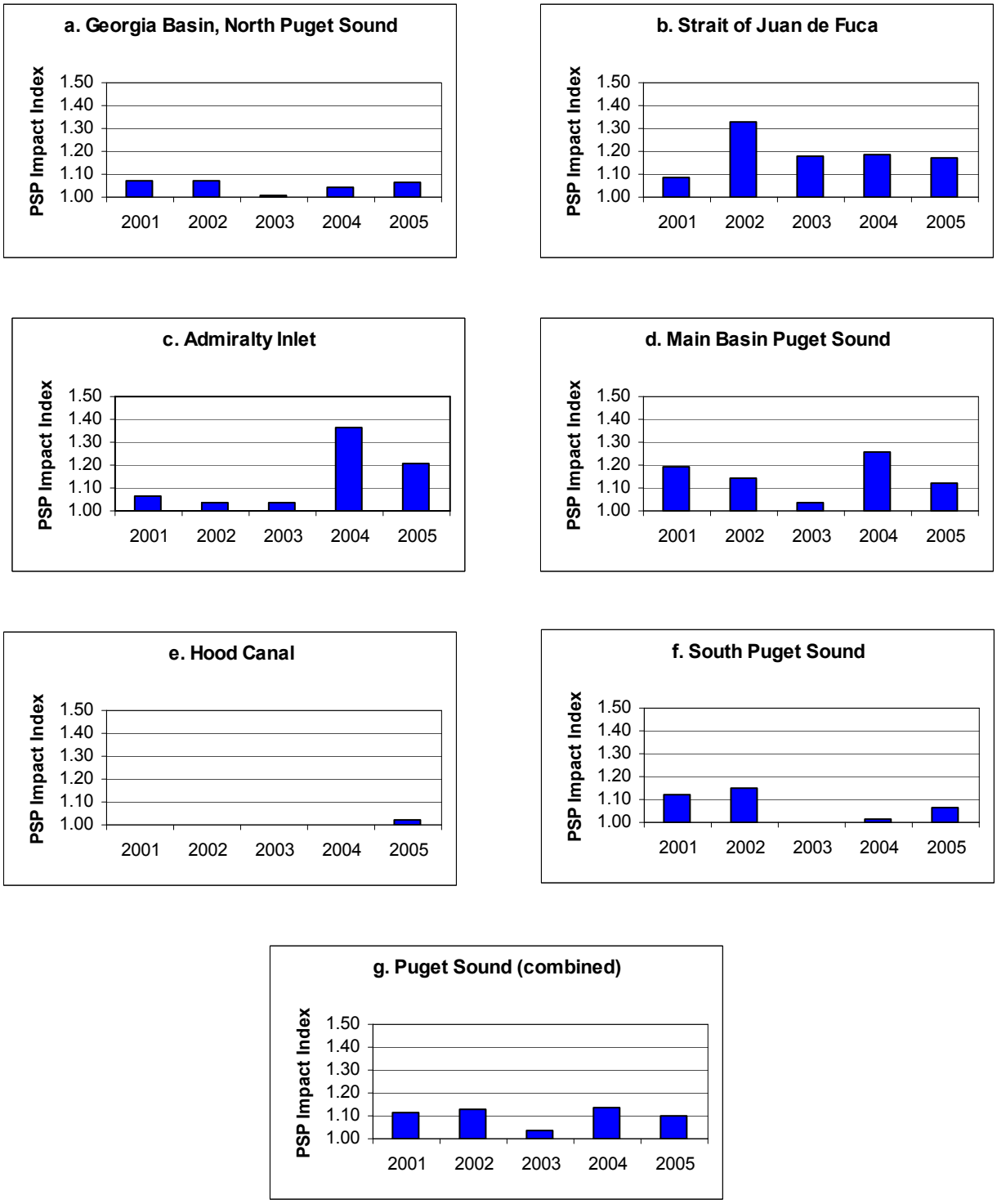


Figure 14 shows PSP results sorted into PSP impact categories (as defined in the legend) for 2005. A pie chart summarizes the fraction of results in each category at each site. Eighteen of 29 sites (62%) had at least minimum PSP impact.

A PSP "Impact Index" was developed by DOH to rank sampling sites according to PSP activity. The PSP Impact Index ranges from 1.0 (no impact) to 3.0 (maximum impact). Figure 15 ranks the 18 sites according to the intensity of PSP activity. Burley Lagoon (South Puget Sound) and Miller Bay (Main Basin) ranked highest in 2005.

Figure 16 compares changes in PSP activity from 2001 through 2005 in six regions of Puget Sound (Fig. 16a-f) and Puget Sound-wide (Fig. 16g). The graphs suggest PSP activity in the last five years was lowest in 2003 in four of six regions (Fig. 16a,c,d,f) and in Puget Sound combined (Fig 16g). PSP impact in the Strait of Juan de Fuca, Admiralty Inlet, and Main Basin dropped significantly in 2005 (Fig 16b, c, and d, respectively). PSP activity increased slightly in Georgia Basin and South Puget Sound (Fig 16a, f). PSP impact appeared in Hood Canal for the first time in five years due to slight impact at Lofall and Seabeck.

RECREATIONAL SHELLFISH PROGRAM

The goal of the Recreational Shellfish Program is to protect the health of recreational harvesters by providing them with sufficient information to make informed decisions about where and when it is safe to harvest shellfish.

Consolidated Contracts

Local health jurisdictions play an important role in protecting the health of recreational shellfish harvesters. All twelve Puget Sound counties and one coastal county received funding through their consolidated contract with DOH for recreational shellfish activities.

Local participation in biotoxin sampling is a key component of the contracts. Over 30% of Puget Sound biotoxin samples were collected by local health jurisdictions in 2005.

Local health jurisdictions implemented a number of recreational shellfish education and outreach programs through consolidated contracts in 2005. This preventive approach to recreational harvester health promotion is a valuable aspect of the consolidated contracts/ local health partnership. Projects in 2005 included participation in community events and fairs, partnerships with local schools and state parks, educational talks, outreach to high risk harvester populations, newsletter production, translated press releases, the first Annual Shellfish Educational Workshop, and local shellfish telephone hotlines.

High Risk Harvest

High risk harvesters are those harvesting populations who do not understand or have

Figure 17. Current Recreational Shellfish Harvest Signs